



NIOSH – The National Institute for Occupational Safety and Health

- Dept. of Health & Human Services
- U.S. Public Health Service
- Centers for Disease Control and Prevention
- Research agency
- Prevention
- Non-regulatory

<http://www.cdc.gov/niosh/>

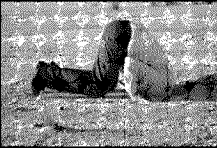

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
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What do we really know about upstream workplace exposure risks?

Diesel Particulate? Biocides? BTEX? Lead in pipe dope? Alcohols? Dermal, ingestion and inhalation? Phenol formaldehyde from resin-coated proppant? Noise? Respirable crystalline silica?



Heat stress H₂S? Polycyclic aromatic hydrocarbons? Hydrochloric acid? NORM?

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1. NIOSH Oil & Gas Safety & Health Research Program
 - a) Safety
 - b) Health
2. Lack of information (1b): diversity, magnitude of potential chemical exposures to workers
3. Unknowns: work practices, products, formulations, equipment, where chemical exposures most likely to occur
4. Emphasis Upstream Oil and Gas H&S: S & h
5. Better understand the h aspects of O&G

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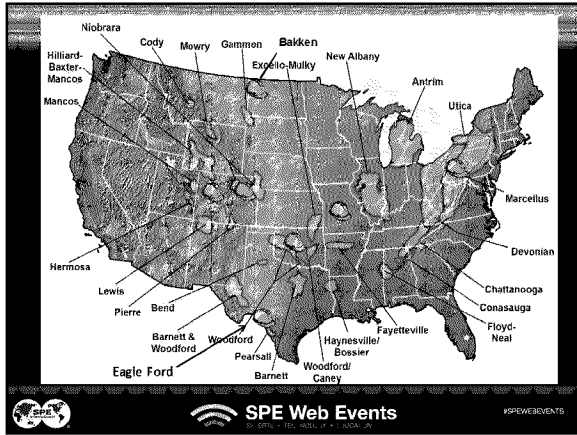
E&P Potential Chemical Exposures?

- Hydrogen sulfide (H_2S)¹
- Volatile organic compounds (NBTEX)¹
- Acid gases (HCL), Caustic (NaOH)¹
- Respirable crystalline silica
- Diesel particulate (DPM)
- Aldehydes (biocides)
- Metals (Pb)²

¹ Gardner, B. Overview and Characteristics of Some Occupational Exposures and Health Risk for Offshore Oil and Gas Installations. *Ann. Occup. Hyg.*, Vol. 47, No. 3, pp. 281-90, 2003
² Khan, F. T. *Tetraethyl Lead Exposure in Children of Oil Field Workers*

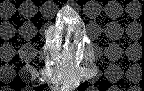
2010-2011 Field Work

- 11 sites, 5 states
- CO (7 sites), AR, PA, TX, ND
- Winter, spring, summer
- Elevation: 300 – 5000 ft.
- Single stage refracs, multi stage, zipper fracs
- Slickwater & gel fracs
- Silica sand, resin coated and ceramic



Silica (Quartz)

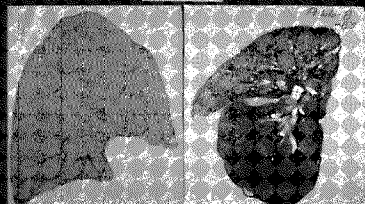
- Silicon (Si) an element
- SiO_2 (silicon dioxide= silica, quartz)
- Respirable crystalline silica (fine dusts)
- Exposures regulated by OSHA
- Silicosis, lung cancer
- Occupational hazard of antiquity
- ≈160 - 200 workers deaths industry wide per year U.S.
- Preventable disease



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Why is silica an occupational health hazard ?

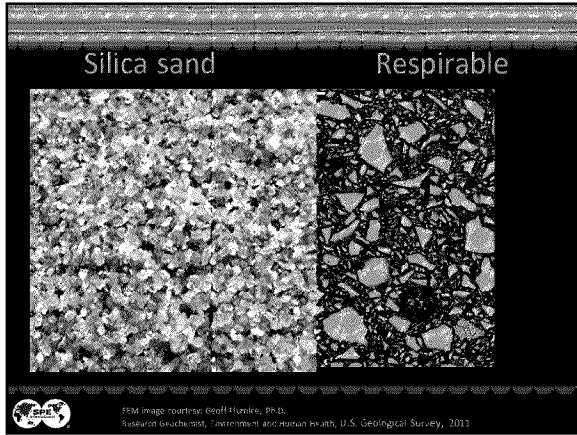
- Silicosis, COPD, other diseases
- Occupational carcinogen
- Incurable
- Irreversible
- Progressive

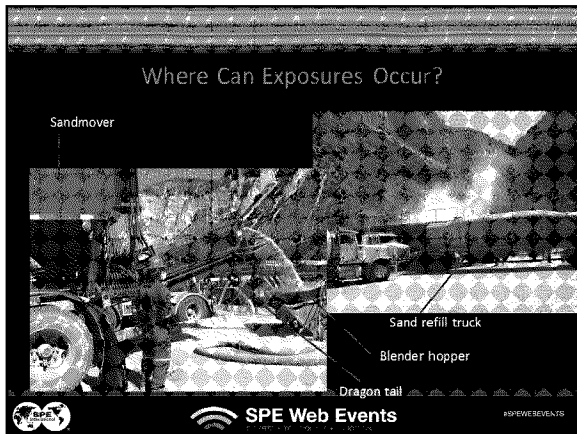


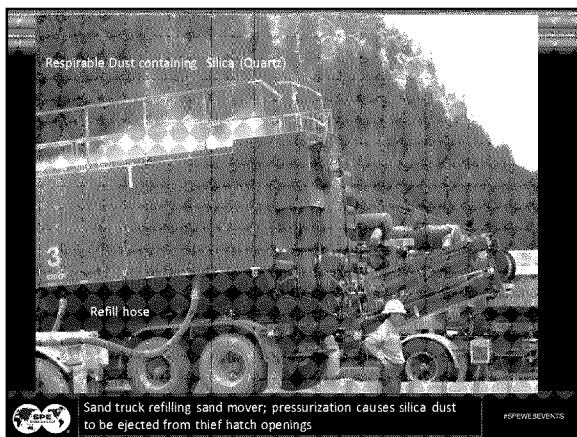
SILICOSIS

Photo: V4i Visualization, Inc./Barnhill

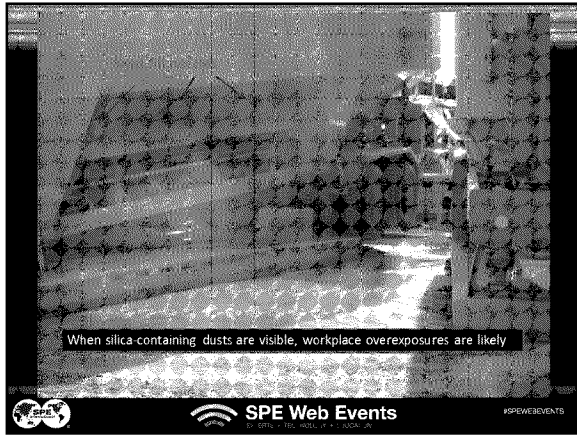
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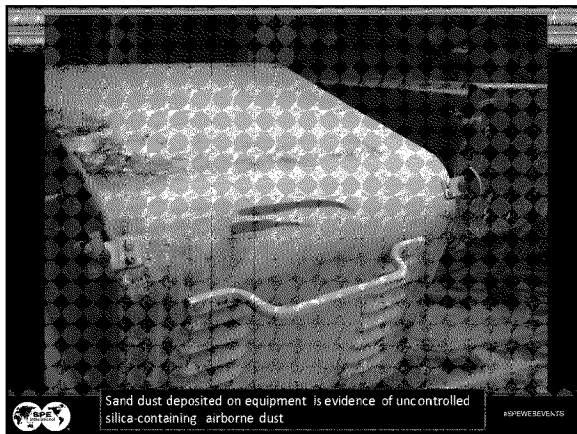


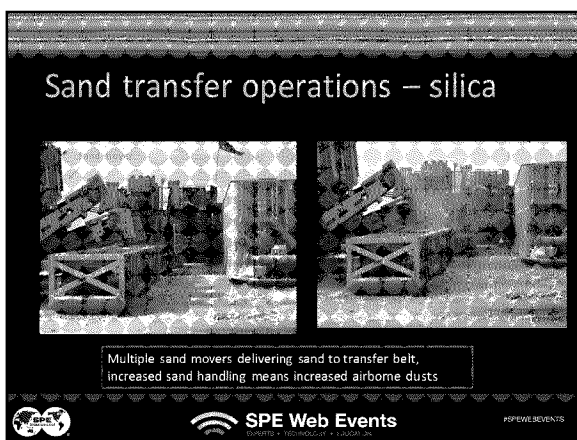


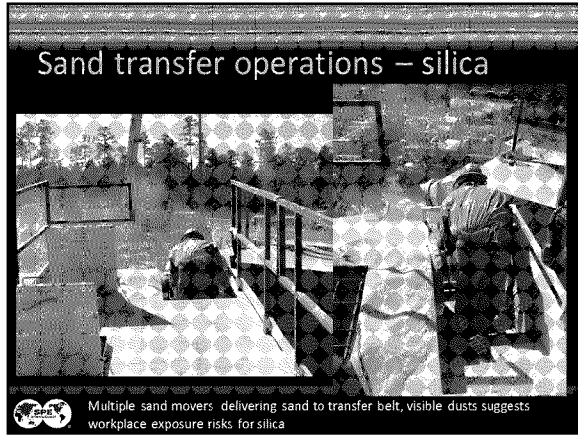




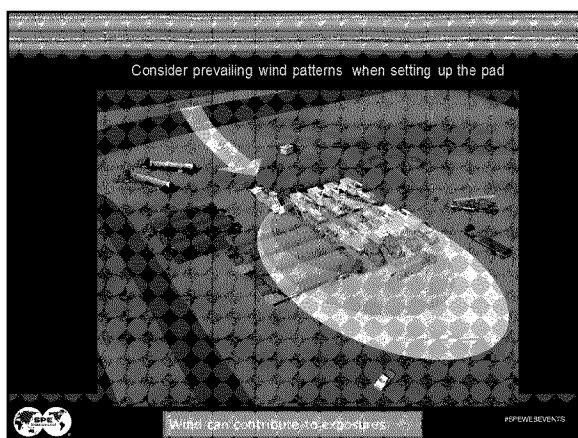














Occupational Exposure Criteria

Respirable silica (quartz)

ACGIH TLV : 0.025 mg/m³ TWA

NIOSH REL: 0.05 mg/m³ TWA

OSHA: $\frac{10 \text{ mg} / \text{m}^3}{(\% \text{ silica} + 2)}$ Resp. dust containing silica

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How much respirable crystalline silica is the NIOSH REL?

500 micrograms (µg's)

NIOSH REL = 0.05 mg/m³ TWA

0.05 mg/m³ = 50 micrograms (µg) / m³

500 micrograms

1 m³ of air = 1,000 liters

Normal breathing rate (moderate work, 1 work day) = 10 m³ (10,000 liters of air)

50 micrograms x 10 m³ = 500 µg's

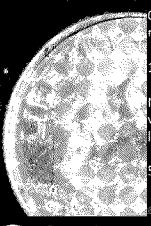




Photo: Geoff Plunkett, USGS



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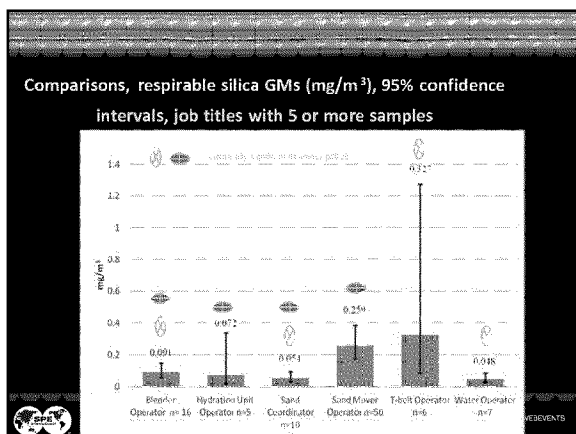
Respirable Silica Results by Location ¹

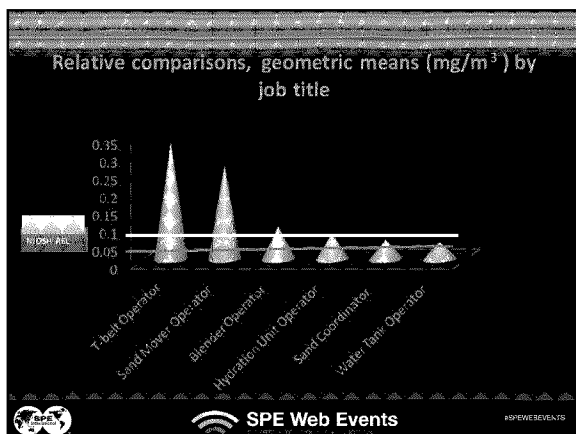
Site	> ACGIH TLV	> NIOSH REL	> OSHA PEL	Total # samples
A	24 (92.3%)	19 (73.1%)	14 (53.9%)	26
B	16 (86.2%)	14 (73.7%)	12 (63.2%)	19
C	5 (62.5%)	5 (62.5%)	4 (50.0%)	8
D	19 (90.5%)	14 (66.7%)	9 (42.9%)	21
E	25 (92.6%)	23 (85.2%)	18 (66.7%)	27
F	4 (40.0%)	1 (10%)	0	10
Total	93 (83.8%)	76 (68.5%)	57 (51.4%)	111

¹ Erwin, Bentzen, Schneider, et al., Occupational Exposures to Respirable Crystalline Silica in Hydraulic Fracturing Jour. Occ. Env. Hyg. Vol 10, Issue 7, May, 2013

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8 Primary Points of Dust Generation

1. Release from top hatches, sand movers
2. Transfer belt under sand movers
3. Site traffic
4. Sand dropping in blender hopper
5. Release from T-belt operations
6. Release from dragon tail
7. Dust ejected from fill ports on sand movers
8. Release from work uniforms

Field Observations

1. Focus: Big S, little h
2. Respirators often not used correctly
3. Respirators used as primary protection
4. Silica not perceived as a hazardous material
5. Tough to get airborne concentrations < OELs






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Hierarchy of Controls

- Eliminate
- Substitute
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment






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Control of Dust Generation

1. Prevention through Design (PtD)
2. Remote operations (if feasible)
3. Substitution (ceramic vs. sand)
4. Implement Engineering Controls
5. Passive enclosures
 - Stilling (staging) curtains
6. Minimize distance that sand falls
7. End caps on fill nozzles
8. Adopt site dust control
9. Effective respiratory protection program

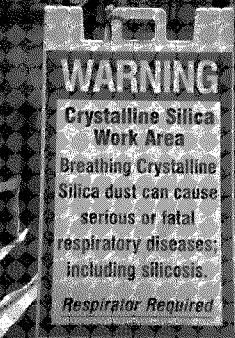



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Communicate the Risk

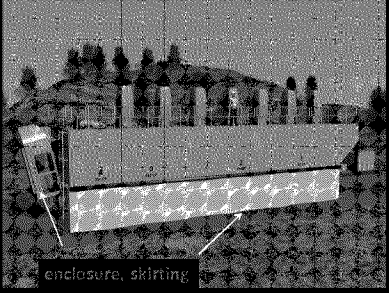
- Signage
- Effective Haz. Comm.
- Include in JSHA's
- Periodic training
- Effective respiratory protection program
- Medical monitoring





WARNING
Crystalline Silica Work Area
Breathing Crystalline Silica dust can cause serious or fatal respiratory diseases including silicosis.
Respirator Required

  **SPE**
Society of Professional Engineers

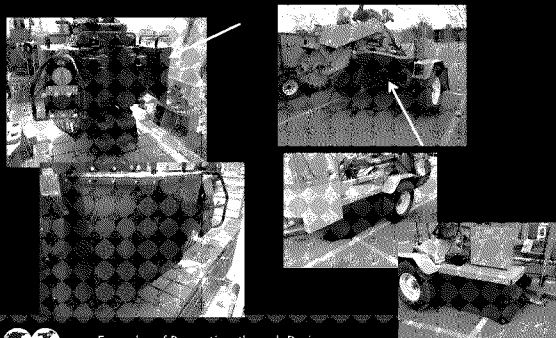
Proposed Controls (passive)




enclosure, skirting

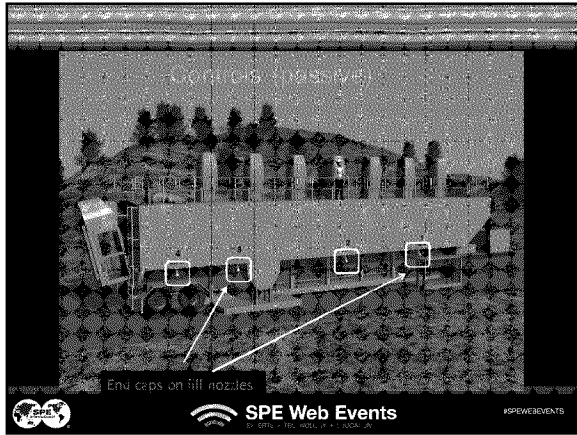
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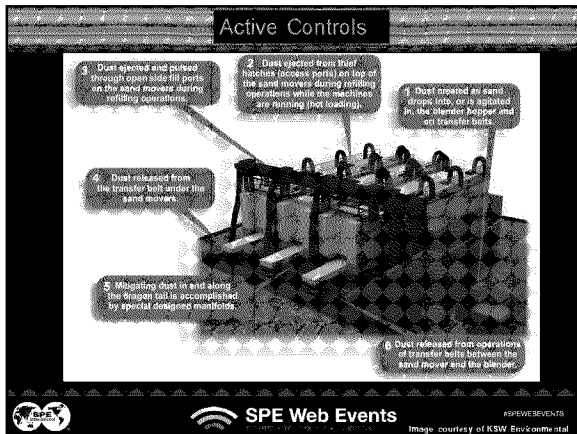
Skirting, shrouding (passive)

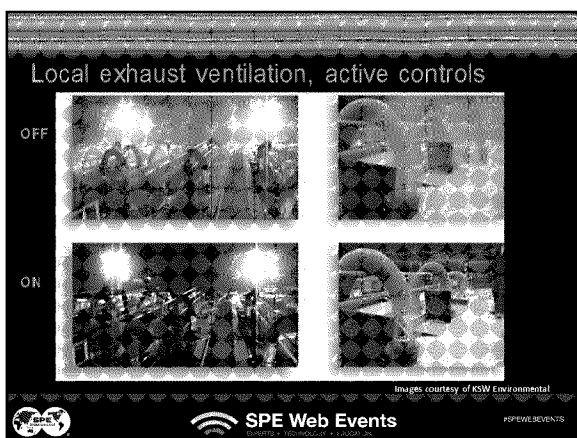


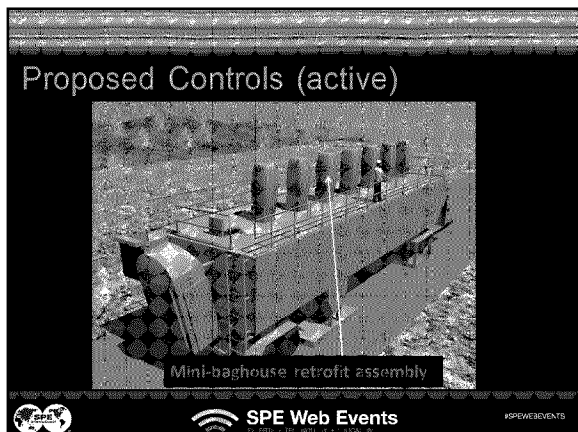
Examples of Prevention through Design



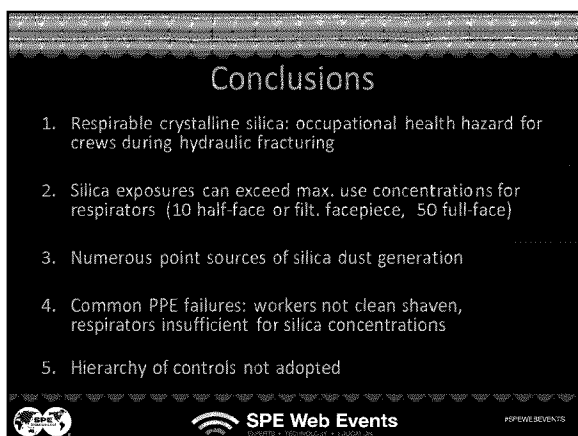














Conclusions (con'd.)



Controls:

1. **Simple:**
 - a. Ensure management + crews understand risks (Hazard Communication)
 - b. End caps on fill nozzles,
 - c. Dust control at worksite,
 - d. Close thief hatches,
 - e. Use staging curtains/enclosures,
 - f. Administrative controls for crews
 - g. Excellent respiratory protection program
 - h. Confirm controls work (IH exposure assessments)
2. **Better:**
 1. All of 1 (a-h)
 2. Use contractors for dust control
 3. Reconfigure sand movers with aftermarket controls
 4. Confirm controls work
3. **Best:**
 1. Purchase machines with silica OEM controls
 2. Confirm controls work



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Industry Engagement in Hydraulic Fracturing Issues

T. Alan Edwards, SPE
Executive Director, American Petroleum Institute
June 3, 2013



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Disclaimer

- The facts are the facts.
- While much of the work described in the presentation has been sponsored by industry associations, the opinions and conclusions offered are mine alone.



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Overview

- EPA involved in 4 significant studies in response to allegations of impacts to groundwater from hydraulic fracturing operations.
 - Dimock, PA – Allegations of G/W contamination and stray gas migration.
 - Parker Co., TX – Allegations of stray gas migration.
 - Pavillion, WY – Allegations of G/W contamination.
 - EPA National HF Study – Retrospective review of 5 sites of alleged G/W contamination.
- EPA's performance in the first 3 studies gives cause for significant concern with the fourth.



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Necessary Standard of Work

- Industry wants EPA's work to meet the highest technical, scientific and professional objectives.
- Industry wants EPA's work to follow recognized standards, procedures and practices (EPA's or others), and operate transparently.
- Industry wants EPA's work to be credible and strongly defensible.
 - All parties must have confidence in the results.
 - Will reduce areas of controversy.
 - Will allow sound development to proceed.
- Unfortunately, much of EPA's work to date has not met these standards.



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Dimock, PA and Parker Co., TX

- Both were in response to public complaints.
 - Allegations of HF induced well failure leading to G/W contamination.
- In both cases, initial conclusions were largely reversed.
 - Limited data, some of questionable quality, agency over-reaction, led operators to challenge EPA's actions.
 - State led evaluations largely ignored by EPA.
 - Better data, more rigorous review, and in-depth analysis led to significantly different conclusions.





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Pavillion, WY

- Citizen complaints regarding odor/taste of shallow groundwater.
- Oil and gas production area for 40+ years.
- 3 significant sampling programs (1 shallow, 2 deep)-- 2 by EPA, 1 by USGS.
 - Attempts to link HF and G/W contamination failed.
 - Shift to deep groundwater evaluations not responsive to public concerns.
- Review of latest USGS sampling program suggested significant technical concerns with prior work by EPA.
 - Monitoring well construction/integrity issues
 - Limited monitoring well productivity
 - Sampling/analytical inconsistencies
 - Unreported spills (diesel and cociant/glycol)






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EPA National HF Study

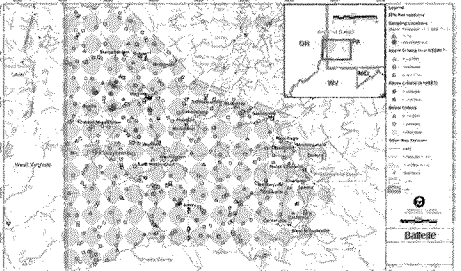
- Study examines 5 "retrospective" sites and 2 "prospective" sites.
 - Study Plan public; disclosure of actual work to date limited.
 - Retrospective study component appears nearly complete.
- API/ANCA initiated companion study to evaluate, validate and enhance overall study effort.
 - Critical review of study plan -- shared with EPA.
 - Significant concerns with QA/QC aspects of plan and their implementation.
 - Independent evaluation of 5 retrospective sites -- shared with EPA.
 - Prepared baseline characterization of each site to allow accurate assessment of "post HF" observations.
 - Significant data available to hindcast baseline conditions
 - EPA progress report described a much more limited sampling effort.






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Locations of Analytes Above Screening Criteria – Washington Co., PA








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Conclusions

- EPA's work in Dimock, Parker Co., or Pavillion has not consistently met either EPA's own guidance/requirements or those offered by other recognized organizations.
- Poor results are affecting public confidence.
- Prior performance causes significant concerns going forward with the National HF Study.
- Industry supports rigorous, scientifically and technically sound studies of HF operations.






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Other Issues Worth Review



- SPE Water Use and Management Workshop
 - October 2013, Galveston, TX
 - Treatment, Recycling, and Consumption management topics
- Rules, Guidance, and Practices
 - BLM final rules out for public comment
 - ASTM Standards development initiative
 - "Centers of Excellence"
 - API "Tif" document updates
- Air Emissions
 - "Quad Q"
 - UT/EDF Study
 - US GHG Emissions Data
- Induced Seismicity
- EPA Diesel Use Guidance



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Questions

Contact Info:
Michael E. Parker, P.E.
Parker Environmental and Consulting, LLC.
(612) 531-1474
ParkerEnt@gmail.com

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